Global Burden of Childhood Epilepsy, Intellectual Disability, and Sensory Impairments

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abstract

BACKGROUND: Estimates of children and adolescents with disabilities worldwide are needed to inform global intervention under the disability-inclusive provisions of the Sustainable Development Goals. We sought to update the most widely reported estimate of 93 million children <15 years with disabilities from the Global Burden of Disease Study 2004.

METHODS: We analyzed Global Burden of Disease Study 2017 data on the prevalence of childhood epilepsy, intellectual disability, and vision or hearing loss and on years lived with disability (YLD) derived from systematic reviews, health surveys, hospital and claims databases, cohort studies, and disease-specific registries. Point estimates of the prevalence and YLD and the 95% uncertainty intervals (UIs) around the estimates were assessed.

RESULTS: Globally, 291.2 million (11.2%) of the 2.6 billion children and adolescents (95% UI: 249.9–335.4 million) were estimated to have 1 of the 4 specified disabilities in 2017. The prevalence of these disabilities increased with age from 6.1% among children aged <1 year to 13.9% among adolescents aged 15 to 19 years. A total of 275.2 million (94.5%) lived in low- and middle-income countries, predominantly in South Asia and sub-Saharan Africa. The top 10 countries accounted for 62.3% of all children and adolescents with disabilities. These disabilities accounted for 28.9 million YLD or 19.9% of the overall 145.3 million (95% UI: 106.9–189.7) YLD from all causes among children and adolescents.

CONCLUSIONS: The number of children and adolescents with these 4 disabilities is far higher than the 2004 estimate, increases from infancy to adolescence, and accounts for a substantial proportion of all-cause YLD.

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WHAT'S KNOWN ON THIS SUBJECT: The World Disability Report 2011 indicated that at least 93 million (~5.1%) children <15 years old had a moderate-to-severe disability and 13 million (0.7%) had a severe disability on the basis of the Global Burden of Disease Study 2004.

WHAT THIS STUDY ADDS: More than 291 million children aged <20 years had epilepsy and intellectual and sensory disabilities in 2017. The top 10 countries accounted for 62% of the children with these disabilities, and 95% lived in low and middle income countries.

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The United Nations' Sustainable Development Goals (SDGs) mandate programs that will ensure inclusive and equitable quality education and promote lifelong learning opportunities for all children and adolescents, including those with disabilities.[1] The majority of children with disabilities live in low- and middle-income countries (LMICs)[2,3] and are less likely to go to school, or if they do attend school, they are more likely to leave school before completing primary or secondary education, resulting in considerable barriers to work and gainful employment.[4–6] They are frequently marginalized in society and are disproportionately vulnerable to neglect, abuse, poverty, and violence.[4] Thus, children and adolescents with disabilities are prone to be left behind under the SDGs era without timely and appropriate intervention from early childhood.[4,5]

Limited global data exist on children and adolescents with disabilities because of insufficient investment in collecting comparable data on different disabilities.[6,7] The global prevalence estimates that are most frequently cited by multilateral agencies, such as the World Health Organization (WHO),[3,7] the United Nations Children's Fund,[2] the United Nations Educational, Scientific and Cultural Organization,[6] the Office of the United Nations High Commissioner for Refugees,[8] the World Bank Group,[5] and, more recently, the US Agency for International Development,[9] were first published in 2008 on the basis of the WHO's Global Burden of Disease Study (GBD) 2004.[10] The GBD estimated that in 2004, at least 93 million children and adolescents (0–15 years) worldwide (5.1% of the global total) lived with a moderate-to-severe disability, and 13 million (0.7%) had a severe disability.[10] These estimates were generated from 4 specific impairments that were modeled as sequelae of specific health disorders: epilepsy, intellectual disability, hearing loss, and vision loss. However, the reported estimates excluded children and adolescents with mild impairments and were based on limited data sources. Additionally, the proportion of preschool-aged children with disabilities, who may be the most likely to benefit from early childhood intervention services, was not reported.

Updated and improved estimates of children and adolescents with disabilities are needed to better quantify the disease burden and the resources required to address the needs and rights of these children as mandated by the SDGs,[1,11] the Convention on the Rights of the Child,[12] the Convention on the Rights of Persons with Disabilities,[13] and the subsisting resolution of the World Health Assembly on Disability[14] and in line with the International Classification of Functioning, Disability, and Health (ICF).[15] Such data are also needed to monitor progress under the SDG era. We, therefore, set out to report the prevalence of childhood epilepsy, intellectual disability, vision loss, or hearing loss among children and adolescents (<20 years) and the associated years lived with disability (YLD) on the basis of data from the GBD 2017[16,17] to complement and update our earlier report for children <5 years of age from the GBD 2016.[18]

METHODS

The GBD provides estimates of non-fatal outcomes for "impairments" (used interchangeably with "disabilities" in the current article), as part of the annual comprehensive assessment of incidence, prevalence, and YLD for several health conditions across 195 countries and territories. Impairments are defined as sequelae of multiple causes for which better data are available to estimate the overall occurrence than for each underlying cause. Four such impairments are developmental intellectual disability, epilepsy, hearing loss, and vision loss. Case definitions and diagnostic criteria for these impairments were based on *International Classification of Diseases, Ninth Revision* (ICD-9) and *International Classification of Diseases, 10th Revision* (ICD-10) codes, complemented with relevant guidelines such as the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*[19] and the Guidelines for Epidemiologic Studies on Epilepsy.[20] A detailed description of the GBD conceptual framework for epilepsy is reported elsewhere.[21] Disorders of intellectual development in the ICD-9 and ICD-10 codes are termed as "developmental intellectual disability" or simply "intellectual disability" in this article and were grouped into 5 bands on the basis of IQ scores: borderline, mild, moderate, severe, and profound intellectual disability. Hearing and visual impairments were similarly classified into bands of severity corresponding to frequency response and visual acuity cutoffs, respectively. These 4 disabilities were selected for comparability with the GBD 2004 estimates for childhood disabilities.

The detailed methodologic techniques used for estimating the burden of each impairment have been reported previously[16–18] and are presented in the Supplemental Information. In brief, the estimation for each condition started with the compilation of all available data inputs from systematic reviews of the literature, hospital and claims databases, health surveys, case notification systems, cohort studies, and multinational survey data. All input data for GBD 2017 are available at the Global Health Data Exchange (http://ghdx.healthdata.org/gbd-2017/data-input-sources). A total of 1675 sources were analyzed for data on the prevalence of intellectual disability (57), hearing loss (355),

TABLE 1 Global and Regional Age-Specific Prevalence of and YLD for Epilepsy in 2017

	No. (95% UI)				
	1–4 y	5–9 y	10–14 y	15–19 y	<20 y
High-income North America					
Prevalence	131 803 (107 432–159 399)	199 970 (157 616–246 093)	216 420 (168 746–265 722)	216 711 (171 356–265 789)	789 737 (632 514–948 176)
Cases per 100 000	767 (625–927)	890 (701–1095)	920 (717–1129)	920 (727–1128)	867 (695–1041)
YLD	51 974 (37 050–69 051)	75 662 (53 611–104 677)	79 999 (55 802–109 880)	77 882 (54 747–107 040)	295 570 (211 251–403 410)
Rate per 100 000	302 (216–402)	337 (238–466)	340 (237–467)	331 (232–454)	325 (232–443)
Western Europe					
Prevalence	126 468 (100 007–156 598)	188 957 (144 255–237 135)	196 335 (151 269–242 173	202 926 (157 762–249 314)	739 764 (574 153–903 671)
Cases per 100 000	712 (563–882)	803 (613–1008)	845 (651–1042)	865 (673–1063)	802 (622–979)
YLD	48 964 (34 429–67 257)	70 905 (49 050–98 578)	72 145 (49 296–98 731)	72 754 (50 216–100 092)	274 710 (192 230–373 788)
Rate per 100 000	276 (194–379)	301 (209–419)	310 (212–425)	310 (214–427)	298 (208–405)
Central Europe, Eastern Europe, and Central Asia					
Prevalence	189 861 (156 308–226 756)	275 179 (221 331–336 004)	256 698 (207 995–311 453)	247 331 (203 706–297 748)	1 004 098 (839 357–1 194 942)
Cases per 100 000	837 (689–1000)	1001 (805–1222)	1066 (864–1293)	1083 (892–1304)	980 (820–1167)
YLD	83 351 (60 394–108 332)	117 909 (86 351–153 388)	108 160 (78 760–144 448)	102 209 (75 128–136 169)	427 137 (315 890–554 788)
Rate per 100 000	368 (266–478)	429 (314–558)	449 (327–600)	448 (329–596)	417 (308–542)
Latin America and the Caribbean					
Prevalence	449 630 (370 510–548 055)	575 028 (459 495–713 720)	609 379 (483 554–749 149)	672 801 (550 138–818 731)	2 420 438 (1 972 412–2 917 913)
Cases per 100 000	1106 (911–1348)	1163 (929–1443)	1237 (981–1521)	1347 (1101–1639)	1213 (988–1462)
YLD	196 721 (145 687–256 747)	245 611 (178 296–324 113)	253 267 (184 956–339 349)	267 238 (198 161–357 961)	1 013 135 (747 175–1 338 725)
Rate per 100 000	484 (358–631)	497 (361–655)	514 (375–689)	535 (397–717)	508 (374–671)
Southeast Asia, East Asia, and Oceania					
Prevalence	737 521 (605 450–893 982)	945 540 (750 994–1 164 348)	958 185 (773 663–1 184 098)	962 589 (783 522–1 177 510)	3 793 040 (3 141 571–4 560 916)
Cases per 100 000	664 (545–804)	701 (557–863)	703 (567–868)	692 (563–846)	687 (569–826)
YLD	331 971 (248 485–440 416)	420 846 (308 919–561 459)	423 461 (308 930–564 083)	419 264 (308 153–556 904)	1 681 681 (1 267 440–2 163 937)
Rate per 100 000	299 (224–396)	312 (229–416)	310 (227–414)	301 (221–400)	305 (230–392)
South Asia					
Prevalence	1 134 129 (892 519–1 402 382)	1 592 310 (1 216 048–2 021 679)	1 626 659 (1 248 656–2 046 161)	1 626 693 (1 279 219–2 022 196)	6 207 938 (5 071 432–7 483 407)
Cases per 100 000	804 (633–994)	889 (679–1129)	915 (702–1151)	914 (719–1136)	875 (715–1055)
YLD	547 600 (384 538–732 918)	760 878 (545 412–1 049 013)	772 626 (562 422–1 054 172)	760 804 (549 690–1 019 818)	2 952 475 (2 180 425–3 869 281)
Rate per 100 000	388 (273–519)	425 (304–586)	434 (316–593)	428 (309–573)	416 (307–545)
Sub-Saharan Africa					
Prevalence	1 324 612 (1 044 953–1 668 665)	1 445 699 (1 089 817–1 874 924)	1 327 538 (1 012 314–1 723 209)	1 174 404 (905 551–1 483 284)	5 610 340 (4 407 396–7 044 475)
Cases per 100 000	1027 (810–1294)	980 (739–1271)	1017 (776–1321)	1062 (819–1341)	1016 (799–1276)
YLD	631 083 (455 159–836 628)	654 829 (453 942–909 475)	594 123 (408 058–828 262)	513 862 (358 361–705 617)	2 561 263 (1 817 398–3 446 823)
Rate per 100 000	489 (353–649)	444 (308–617)	455 (313–635)	465 (324–638)	464 (329–624)
North Africa and the Middle East					
Prevalence	529 020 (425 793–647 712)	605 404 (476 471–745 640)	513 903 (406 382–628 706)	439 954 (351 097–534 851)	2 216 563 (1 779 281–2 654 106)
Cases per 100 000	1025 (825–1255)	980 (771–1207)	908 (718–1111)	838 (669–1019)	942 (756–1128)
YLD	236 221 (173 908–315 055)	264 780 (193 166–360 277)	224 422 (163 680–298 144)	190 429 (137 334–255 005)	975 171 (719 368–1 300 365)
Rate per 100 000	458 (337–611)	429 (313–583)	397 (289–527)	363 (262–486)	415 (306–553)
Global					
Prevalence	4 704 742 (3 906 017–5 688 824)	5 951 176 (4 780 635–7 281 786)	5 825 559 (4 699 604–7 042 917)	5 674 377 (4 682 960–6 831 607)	23 251 109 (19 477 175–27 607 857
Cases per 100 000	867 (720–1048)	900 (723–1101)	916 (739–1107)	920 (760–1108)	896 (751–1064)
YLD	2 161 753 (1 622 637–2 784 049)	2 661 547 (1 961 247–3 478 308)	2 576 792 (1 943 858–3 419 294)	2 456 333 (1 856 830–3 223 372)	10 371 105 (7 852 990–13 253 967)
Rate per 100 000	398 (299–513)	403 (297–526)	405 (306–537)	398 (301–523)	400 (303–511)

TABLE 2 Global and Regional Age-Specific Prevalence of and YLD for Intellectual Disability in 2017

	No. (95% UI)				
	1–4 y	5–9 y	10–14 y	15–19 y	<20 y
High-income North America					
Prevalence	312 301 (242 878–382 044)	406 645 (316 939–500 868)	421 064 (328 142–518 193)	414 992 (323 170–511 232)	1 631 108 (1 272 711–2 004 735)
Cases per 100 000	1817 (1413–2223)	1809 (1410–2228)	1789 (1394–2202)	1761 (1372–2170)	1792 (1398–2202)
YLD	56 625 (42 735–71 313)	75 118 (55 834–96 354)	77 205 (57 942–99 252)	74 525 (55 493–94 510)	296 285 (222 764–374 979)
Rate per 100 000	329 (249–415)	334 (248–429)	328 (246–422)	316 (236–401)	325 (245–412)
Western Europe					
Prevalence	306 760 (244 393–366 154)	407 635 (323 805–486 663)	398 547 (316 114–476 539)	394 895 (315 514–472 494)	1 581 607 (1 257 082–1 888 734)
Cases per 100 000	1727 (1376–2062)	1733 (1377–2069)	1715 (1360–2051)	1684 (1345–2015)	1714 (1362–2047)
YLD	58 830 (44 214–76 755)	79 235 (59 655–103 358)	77 719 (58 698–102 767)	76 870 (57 392–100 563)	306 181 (231 706–397 589)
Rate per 100 000	331 (249–432)	337 (254–439)	334 (253–442)	328 (245–429)	332 (251–431)
Central Europe, Eastern Europe, and Central Asia					
Prevalence	464 555 (372 176–551 946)	566 007 (456 083–671 043)	490 842 (396 378–579 410)	456 221 (369 000–539 606)	2 085 228 (1 684 719–2 467 164)
Cases per 100 000	2048 (1641–2434)	2058 (1658–2440)	2038 (1646–2406)	1998 (1616–2363)	2036 (1645–2409)
YLD	96 975 (74 084–123 808)	123 931 (93 748–158 428)	108 941 (82 212–141 470)	100 356 (75 919–129 790)	450 975 (344 233–576 327)
Rate per 100 000	428 (327–546)	451 (341–576)	452 (341–587)	440 (333–568)	440 (336–563)
Latin America and the Caribbean					
Prevalence	672 585 (546 288–790 809)	793 565 (640 531–936 587)	771 280 (620 371–911 461)	757 768 (609 956–895 890)	3 170 947 (2 566 782–3 741 437)
Cases per 100 000	1654 (1343–1944)	1605 (1295–1894)	1565 (1259–1850)	1517 (1221–1794)	1589 (1286–1875)
YLD	163 130 (122 299–205 398)	192 502 (141 828–249 593)	186 842 (138 637–245 523)	180 520 (133 886–238 899)	765 956 (572 889–985 737)
Rate per 100 000	401 (301–505)	389 (287–505)	379 (281–498)	361 (268–478)	384 (287–494)
Southeast Asia, East Asia, and Oceania					
Prevalence	1 989 600 (1 551 695–2 417 553)	2 388 846 (1 858 076–2 909 389)	2 366 591 (1 837 990–2 863 620)	2 342 392 (1 825 186–2 833 713)	9 635 177 (7 508 265–11 680 166)
Cases per 100 000	1790 (1396–2175)	1770 (1377–2156)	1735 (1348–2100)	1683 (1311–2036)	1745 (1360–2116)
YLD	338 527 (261 223–424 819)	409 425 (314 267–510 283)	406 080 (315 679–509 454)	400 529 (312 259–498 027)	1 647 992 (1 282 960–2 052 003)
Rate per 100 000	305 (235–382)	303 (233–378)	298 (231–374)	288 (224–358)	299 (232–372)
South Asia					
Prevalence	8 814 255 (6 626 639–10 976 227)	10 915 694 (8 235 801–13 631 549)	10 497 333 (7 918 391–13 093 706)	10 172 283 (7 644 114–12 708 838)	42 491 040 (31 992 788–53 011 211)
Cases per 100 000	6247 (4696–7779)	6093 (4597–7610)	5903 (4453–7363)	5717 (4296–7142)	5990 (4510–7474)
YLD	810 729 (612 510–1 052 819)	1 038 830 (788 263–1 334 037)	1 020 827 (777 147–1 297 493)	987 227 (753 048–1 252 961)	4 042 934 (3 097 570–5 160 238)
Rate per 100 000	575 (434–746)	580 (440–745)	574 (437–730)	555 (423–704)	570 (437–727)
Sub-Saharan Africa					
Prevalence	3 165 296 (2 481 170–3 837 016)	3 334 212 (2 597 892–4 095 851)	2 843 521 (2 215 008–3 491 657)	2 321 894 (1 805 326–2 855 238)	12 578 273 (9 852 736–15 399 332)
Cases per 100 000	2455 (1924–2976)	2261 (1762–2777)	2179 (1698–2676)	2099 (1632–2581)	2279 (1785–2790)

TABLE 2 Continued

	No. (95% UI)				
	1–4 y	5–9 y	10–14 y	15–19 y	<20 y
YLD	537 270 (403 404–681 216)	502 903 (371 463–654 997)	427 855 (318 385–563 513)	344 876 (257 747–450 141)	1 978 503 (1 492 394–2 545 605)
Rate per 100 000	417 (313–528)	341 (252–444)	328 (244–432)	312 (233–407)	358 (270–461)
North Africa and the Middle East					
Prevalence	2 095 975 (1 607 222–2 594 440)	2 407 074 (1 843 226–2 986 253)	2 134 977 (1 635 729–2 648 684)	1 888 277 (1 448 419–2 345 875)	9 063 331 (6 947 456–11 240 448)
Cases per 100 000	4062 (3115–5028)	3896 (2984–4834)	3773 (2891–4681)	3596 (2759–4468)	3853 (2954–4779)
YLD	247 026 (186 292–312 698)	277 132 (211 358–354 743)	244 547 (186 614–310 299)	214 982 (164 447–274 406)	1 049 302 (801 194–1 335 594)
Rate per 100 000	479 (361–606)	449 (342–574)	432 (330–548)	409 (313–523)	446 (341–568)
Global					
Prevalence	18 008 445 (13 909 115–22 144 997)	21 463 907 (16 582 655–26 376 300)	20 163 862 (15 573 910–24 783 030)	19 007 495 (14 683 193–23 427 643)	83 209 866 (64 448 368–102 067 901)
Cases per 100 000	3318 (2563–4080)	3246 (2508–3989)	3169 (2448–3895)	3083 (2382–3800)	3207 (2484–3934)
YLD	2 349 727 (1 817 711–2 945 999)	2 754 614 (2 118 761–3 466 366)	2 603 898 (2 016 091–3 243 552)	2 437 342 (1 889 411–3 031 441)	10 753 999 (8 286 290–13 378 933)
Rate per 100 000	433 (335–543)	417 (320–524)	409 (317–510)	395 (306–492)	414 (319–516)

epilepsy (455), and vision loss (808). Efforts were made to (1) optimize the comparability of data derived from various sources by using different methods, (2) find a consistent set of estimates across prevalence data, and (3) generate estimates for locations with sparse or no data by using available information from other locations combined with covariates. Prevalence estimates were produced by using DisMod-MR 2.1, a statistical modeling technique developed for the GBD project (Supplemental Fig 5).[22] This is a Bayesian meta-regression tool that synthesizes epidemiological data for fatal and non-fatal health outcomes from disparate settings and sources, adjusting for different case definitions, diagnostic criteria, or sampling methods, to generate internally consistent estimates by geographical location, year, age group, and sex. The validity of DisMod has been widely reported.[16–18,22]

YLD, defined as the years of life lived with a condition in a less than ideal health state, are designed to provide a comparable measure of disease burden across diverse health conditions and impairments rather than a measure of functional status, as described in ICF.[15] To calculate YLD for the 4 disabilities, the estimated prevalence of each disability was multiplied by an assigned disability weight. Disability weights are the population assessment of magnitude of health loss from specific health outcomes measured on a scale from 0 to 1, in which 0 equals a state of perfect health and 1 equals death. The disability weights were estimated from multicountry population-based surveys, as described in detail elsewhere.[18,23]

The global estimates of the prevalence and YLD for the 4 disabilities in children and adolescents were disaggregated by age group (children: <1, 1–4, 5–9 years; adolescents: 10–14 and 15–19 years), sex, and geographical regions (high-income North America, Western Europe, Central and Eastern Europe and Central Asia, Latin America and the Caribbean, Southeast and East Asia and Oceania, South Asia, Sub-Saharan Africa, and North Africa and the Middle East). The selected locations are not geopolitical units, but groupings of countries created by GBD for analytical purposes. All computations in the GBD were conducted 1000 times to propagate uncertainty around the estimates for prevalence and YLD. At every step in the modeling process, the distributions were assessed for the sampling error of data inputs, the uncertainty of data corrections for measurement errors, the uncertainty in coefficients from model fit, and the uncertainty of severity distributions and disability weights. The corresponding uncertainty intervals (UIs) for prevalence and YLD estimates of the 4 disabilities were defined at the 2.5th and 97.5th value of 1000 draws. As with all GBD articles, the substantive data that formed the basis of this analysis[16,17] adhered to the Guidelines for Accurate and Transparent Health Estimates Reporting, which include recommendations on the documentation of data sources,

TABLE 3 Global and Regional Age-Specific Prevalence of and YLD for Hearing Loss in 2017

	No. (95% UI)				
	1–4 y	5–9 y	10–14 y	15–19 y	<20 y
High-income North America					
Prevalence	258 142 (225 327–295 461)	478 573 (426 090–537 100)	526 205 (471 867–585 743)	733 490 (664 602–818 883)	2 017 260 (1 870 427–2 183 386)
Cases per 100 000	1502 (1311–1719)	2129 (1895–2389)	2236 (2005–2489)	3113 (2821–3475)	2216 (2054–2398)
YLD	12 408 (8680–17 110)	22 325 (15 402–30 559)	26 443 (18 237–36 819)	30 600 (21 450–41 400)	93 525 (65 864–126 933)
Rate per 100 000	72 (50–100)	99 (69–136)	112 (77–156)	130 (91–176)	103 (72–139)
Western Europe					
Prevalence	226 464 (198 409–259 596)	454 724 (401 634–515 000)	510 865 (453 338–573 776)	854 951 (768 534–958 165)	2 064 471 (1 900 504–2 243 406)
Cases per 100 000	1275 (1117–1462)	1933 (1708–2190)	2198 (1951–2469)	3646 (3277–4086)	2237 (2059–2431)
YLD	9166 (6304–12 735)	16 542 (11 121–23 162)	18 457 (12 695–25 847)	24 027 (16 478–34 327)	69 441 (48 083–96 832)
Rate per 100 000	52 (35–72)	70 (47–98)	79 (55–111)	102 (70–146)	75 (52–105)
Central Europe, Eastern Europe, and Central Asia					
Prevalence	446 534 (393 229–505 136)	867 575 (761 631–978 052)	853 600 (759 658–961 526)	1 156 592 (1 039 959–1 289 852)	3 355 115 (3 098 211–3 626 580)
Cases per 100 000	1969 (1734–2227)	3155 (2769–3556)	3545 (3155–3993)	5066 (4555–5649)	3276 (3025–3541)
YLD	19 754 (13 847–27 355)	34 888 (23 943–48 270)	34 657 (23 805–47 919)	38 964 (27 198–53 796)	130 484 (91 327–179 383)
Rate per 100 000	87 (61–121)	127 (87–176)	144 (99–199)	171 (119–236)	127 (89–175)
Latin America and the Caribbean					
Prevalence	843 578 (744 767–954 872)	1 640 439 (1 443 332–1 839 080)	1 853 695 (1 648 833–2 080 510)	2 670 666 (2 406 587–2 973 854)	7 076 049 (6 546 644–7 652 670)
Cases per 100 000	2074 (1831–2348)	3317 (2919–3719)	3762 (3347–4223)	5347 (4818–5954)	3546 (3280–3835)
YLD	36 917 (25 862–51 437)	64 279 (43 830–88 858)	72 599 (50 013–101 588)	87 004 (60 705–120 938)	265 671 (184 402–365 704)
Rate per 100 000	91 (64–126)	130 (89–180)	147 (102–206)	174 (122–242)	133 (92–183)
Southeast Asia, East Asia, and Oceania					
Prevalence	2 937 855 (2 637 971–3 247 557	5 847 100 (5 185 984–6 566 636)	6 652 840 (5 969 283–7 447 327)	9 517 169 (8 599 529–10 544 702)	25 253 888 (23 356 813–27 245 250)
Cases per 100 000	2643 (2374–2922)	4333 (3844–4867)	4878 (4377–5460)	6837 (6178–7575)	4574 (4231–4935)
YLD	147 715 (103 706–203 433)	258 411 (179 943–352 506)	295 134 (205 286–407 958)	346 117 (242 624–475 054)	1 070 358 (750 476–1 466 477)
Rate per 100 000	133 (93–183)	192 (133–261)	216 (151–299)	249 (174–341)	194 (136–266)
South Asia					
Prevalence	3 931 287 (3 566 450–4 315 347)	7 908 429 (7 057 869–8 818 810)	8 847 058 (7 976 611–9 814 130)	12 033 855 (10 927 238–13 319 010)	33 081 529 (30 758 299–35 615 041)
Cases per 100 000	2786 (2528–3058)	4415 (3940–4923)	4975 (4485–5519)	6763 (6141–7485)	4664 (4336–5021)
YLD	209 056 (146 539–286 880)	359 966 (252 910–485 911)	399 390 (275 291–552 742)	457 025 (321 410–630 307)	1 455 912 (1 023 230–1 979 015)
Rate per 100 000	148 (104–203)	201 (141–271)	225 (155–311)	257 (181–354)	205 (144–279)
Sub-Saharan Africa					
Prevalence	3 694 805 (3 352 273–4 064 331)	6 576 843 (5 912 292–7 295 890)	6 363 670 (5 763 444–7 037 152)	7 182 174 (6 591 941–7 868 098)	24 215 356 (22 583 511–25 985 485)

TABLE 3 Continued

	No. (95% UI)				
	1–4 y	5–9 y	10–14 y	15–19 y	<20 y
Cases per 100 000	2866 (2600–3152)	4460 (4009–4947)	4877 (4417–5393)	6493 (5959–7113)	4387 (4092–4708)
YLD	239 641 (167 087–325 126)	355 441 (249 963–475 154)	348 323 (244 318–470 735)	331 536 (234 376–448 129)	1 320 256 (937 865–1 765 546)
Rate per 100 000	186 (130–252)	241 (170–322)	267 (187–361)	300 (212–405)	239 (170–320)
North Africa and the Middle East					
Prevalence	751 019 (652 720–873 241)	1 405 634 (1 230 855–1 586 991)	1 443 894 (1 271 286–1 632 521)	1 941 910 (1 732 125–2 175 269)	5 591 434 (5 144 265–6 077 669)
Cases per 100 000	455 (1265–1692)	2275 (1992–2569)	2552 (2247–2885)	3699 (3299–4143)	2377 (2187–2584)
YLD	30 533 (20 961–42 481)	54 000 (36 989–74 896)	56 630 (38 685–79 072)	63 515 (43 877–88 736)	207 788 (144 685–286 606)
Rate per 100 000	59 (41–82)	87 (60–121)	100 (68–140)	121 (84–169)	88 (62–122)
Global					
Prevalence	13 244 864 (11 950 478–14 667 046)	25 468 776 (22 734 486–28 377 208)	27 358 599 (24 627 508–30 360 794)	36 577 235 (33 265 797–40 257 224)	103 904 538 (96 545 635–111 630 666)
Cases per 100 000	2440 (2202–2703)	3852 (3438–4292)	4300 (3871–4772)	5933 (5396–6530)	4005 (3721–4302)
YLD	711 795 (499 549–978 438)	1 177 588 (826 177–1 586 023)	1 264 660 (880 741–1 742 484)	1 395 869 (982 697–1 908 896)	4 662 724 (3 290 463–6 304 785)
Rate per 100 000	131 (92–180)	178 (125–240)	199 (138–274)	226 (159–310)	180 (127–243)

estimation methods, statistical analysis, and statistical code.[24]

RESULTS

Globally, the population of children and adolescents was ~2.6 billion in 2017, of whom 291.2 million (95% UI: 249.9–335.4), or 11.2% (95% UI: 10.0–12.5), were estimated to have 1 of the 4 disabilities examined (Tables 1–4). Approximately 152.3 million (52.3%) were male, although the sex pattern varied across the disabilities. The prevalence of these disabilities increased with age, from 6.1% among all the ~138 million children aged <1 year to 13.9% among the roughly 616 million adolescents aged 15 to 19 years. A total of 16 million (95% UI: 13.4–18.9 [5.5%]) lived in high-income countries, and 275.2 million (95% UI: 236.4–316.5 [94.5%]) lived in LMIC. Of all the children and adolescents with disabilities, 8.4 million (2.9%) were aged <1 year, 47.9 million (16.4%) were aged 1 to 4 years, 73.5 million (25.2%) were aged 5 to 9 years, 75.9 million (26.1%) were aged 10 to 14 years, and 85.6 million (29.4%) were aged 15 to 19 years. Thus, a total of 205.6 million (70.6%) were <15 years of age. These 4 disabilities accounted for 28.9 million YLD (or 19.9%) of the overall 145.3 million (95% UI: 106.9–189.7) YLD among children and adolescents from all causes of fatal and non-fatal outcomes included in the GBD 2017.

The prevalence of hearing loss rose from 0.9% among children aged <1 year to 5.9% (95% UI: 5.4%–6.5%) among adolescents aged 15 to 19 years (Fig 1). Vision loss rose from 1.1% among children aged <1 year to 3.9% (95% UI: 3.4%–4.6%) among adolescents aged 15 to 19 years. The prevalence of intellectual disability and epilepsy remained largely constant at ~3% and 0.9%, respectively, in all age groups. Among all children and adolescents, the disability-specific prevalence was 0.9% (95% UI: 0.8%–1.1%) for epilepsy, 3.2% (95% UI: 2.5%–3.9%) for intellectual disability, 3.1% (95% UI: 2.7%–3.6%) for vision loss, and 4.0% (95% UI: 3.7%–4.3%) for hearing loss. However, epilepsy and intellectual disability were associated with the highest YLD in all age groups, which were significantly higher than sensory disabilities.

South Asia accounted for the highest prevalence of intellectual disability (6.0% [95% UI: 4.5%–7.5%]), hearing loss (4.7% [95% UI: 4.3%–5.0%]), and vision loss (3.7% [95% UI: 3.2%–4.2%]), whereas Latin America and the Caribbean recorded the highest prevalence of epilepsy (1.2% [95% UI: 1.0%–1.5%]), as shown in Fig 2. Epilepsy was least prevalent in Southeast and East Asia and Oceania (0.7% [95% UI: 0.6%–0.8%]), and intellectual disability was least prevalent in Latin America and the Caribbean (1.6% [95% UI: 1.3%–1.9%]), whereas vision loss

TABLE 4 Global and Regional Age-Specific Prevalence of and YLD for Vision Loss in 2017

	No. (95% UI)				
	1–4 y	5–9 y	10–14 y	15–19 y	<20 y
High-income North America					
Prevalence	152 623 (118 137–187 434)	290 067 (216 569–380 633)	325 847 (245 317–433 303)	332 019 (260 911–415 580)	1 114 609 (893 445–1 366 118)
Cases per 100 000	888 (687–1090)	1290 (963–1693)	1385 (1042–1841)	1409 (1107–1764)	1224 (981–1501)
YLD	6825 (4491–9800)	12 497 (7946–18 913)	13 922 (9109–20 643)	14 080 (9443–20 526)	48 069 (31 567–70 783)
Rate per 100 000	40 (26–57)	56 (35–84)	59 (39–88)	60 (40–87)	53 (35–78)
Western Europe					
Prevalence	276 367 (198 687–374 997)	517 470 (353 529–726 275)	525 529 (358 367–760 147)	518 419 (371 643–710 943)	1 863 897 (1 406 494–2 458 616)
Cases per 100 000	1556 (1119–2111)	2200 (1503–3088)	2261 (1542–3271)	2211 (1585–3031)	2020 (1524–2664)
YLD	12 670 (8363–18 679)	22 999 (14 561–35 761)	23 903 (15 661–36 263)	24 246 (16 137–35 060)	85 277 (56 719–126 152)
Rate per 100 000	71 (47–105)	98 (62–152)	103 (67–156)	103 (69–149)	92 (61–137)
Central Europe, Eastern Europe, and Central Asia					
Prevalence	564 728 (440 263–703 012)	941 642 (717 458–1 223 861)	868 204 (677 153–1 113 574)	846 765 (688 153–1 039 601)	3 283 489 (2 696 872–3 979 988)
Cases per 100 000	2490 (1941–3100)	3424 (2609–4450)	3605 (2812–4624)	3709 (3014–4553)	3206 (2633–3886)
YLD	23 331 (15 339–33 908)	37 060 (23 671–57 112)	33 650 (22 175–50 785)	32 090 (21 729–46 690)	129 096 (86 179–190 154)
Rate per 100 000	103 (68–150)	135 (86–208)	140 (92–211)	141 (95–204)	126 (84–186)
Latin America and the Caribbean					
Prevalence	740 115 (608 175–891 456)	1 382 342 (1 139 624–1 686 144)	1 722 148 (1 458 855–2 078 414)	2 134 390 (1 864 828–2 454 466)	6 060 394 (5 274 074–6 953 437)
Cases per 100 000	1820 (1495–2192)	2795 (2305–3410)	3495 (2961–4218)	4273 (3733–4914)	3037 (2643–3484)
YLD	35 105 (24 358–49 102)	56 438 (38 220–82 876)	63 224 (43 422–93 124)	71 838 (49 073–102 168)	231 800 (161 066–330 075)
Rate per 100 000	86 (60–121)	114 (77–168)	128 (88–189)	144 (98–205)	116 (81–165)
Southeast Asia, East Asia, and Oceania					
Prevalence	2 249 931 (1 808 000–2 713 770)	3 932 438 (3 111 842–4 917 097)	4 413 990 (3 605 469–5 471 494)	4 703 742 (4 018 023–5 517 485)	15 585 040 (13 235 355–18 269 625)
Cases per 100 000	2024 (1627–2442)	2914 (2306–3644)	3236 (2644–4012)	3379 (2887–3964)	2823 (2397–3309)
YLD	109 196 (76 200–153 579)	166 445 (111 487–245 186)	176 644 (121 421–254 986)	181 132 (126 902–254 871)	653 115 (455 897–924 467)
Rate per 100 000	98 (69–138)	123 (83–182)	130 (89–187)	130 (91–183)	118 (83–167)
South Asia					
Prevalence	3 774 616 (3 077 028–4 508 330)	6 439 687 (5 251 987–7 862 311)	7 183 140 (6 119 227–8 571 685)	8 143 890 (7 174 906–9 255 169)	26 038 313 (22 730 901–29 883 169)
Cases per 100 000	2675 (2181–3195)	3595 (2932–4389)	4039 (3441–4820)	4577 (4032–5201)	3671 (3205–4213)
YLD	165 553 (113 090–235 319)	245 087 (163 525–364 047)	249 088 (168 740–368 544)	261 408 (181 428–376 079)	948 988 (648 070–1 367 226)
Rate per 100 000	117 (80–167)	137 (91–203)	140 (95–207)	147 (102–211)	134 (91–193)
Sub-Saharan Africa					
Prevalence	2 648 821 (2 192 343–3 177 168)	4 543 637 (3 814 398–5 446 542)	4 907 105 (4 263 876–5 738 216)	4 973 223 (4 439 848–5 562 714)	17 405 890 (15 387 972–19 716 012)
Cases per 100 000	2055 (1700–2464)	3081 (2587–3693)	3761 (3268–4398)	4496 (4014–5029)	3154 (2788–3572)
YLD	129 586 (91 767–177 285)	178 202 (122 692–257 198)	172 247 (119 122–245 839)	161 966 (113 190–226 755)	667 326 (471 998–937 436)

TABLE 4 Continued

	No. (95% UI)				
	1–4 y	5–9 y	10–14 y	15–19 y	<20 y
Rate per 100 000	101 (71–138)	121 (83–174)	132 (91–188)	146 (102–205)	121 (86–170)
North Africa and the Middle East					
Prevalence	1 270 261 (1 006 150–1 584 554)	2 128 785 (1 665 430–2 721 426)	2 186 398 (1 774 129–2 745 766)	2 218 003 (1 877 690–2 634 071)	7 960 528 (6 721 789–9 429 083)
Cases per 100 000	2462 (1950–3071)	3446 (2696–4405)	3864 (3136–4853)	4224 (3576–5017)	3384 (2858–4009)
YLD	56 999 (38 277–81 141)	82 725 (53 508–125 192)	79 230 (53 191–119 232)	76 351 (52 324–110 075)	304 847 (206 858–442 931)
Rate per 100 000	110 (74–157)	134 (87–203)	140 (94–211)	145 (100–210)	130 (88–188)
Global					
Prevalence	11 902 507 (9 685 418–14 340 209)	20 584 553 (16 619 635–25 501 975)	22 554 407 (18 878 363–27 433 881)	24 339 696 (21 124 978–28 083 187)	80 857 974 (69 402 207–94 059 458)
Cases per 100 000	2193 (1785–2642)	3113 (2514–3857)	3545 (2967–4312)	3948 (3427–4556)	3116 (2675–3625)
YLD	549 006 (378 690–770 472)	818 335 (546 869–1 207 657)	829 363 (566 152–1 214 034)	842 676 (582 361–1 198 086)	3 133 280 (2 171 484–4 467 090)
Rate per 100 000	101 (70–142)	124 (83–183)	130 (89–191)	137 (94–194)	121 (84–172)

(1.2% [95% UI: 1.0%–1.5%]) and hearing loss (2.2% [95% UI: 2.1%–2.4%] were least prevalent in high-income North America. South Asia (0.6% [95% UI: 0.4%–0.7%]) and Latin America and the Caribbean (0.5% [95% UI: 0.4%–0.7%]) were associated with the highest YLD rates for intellectual disability and epilepsy, respectively. South Asia (107.8 million or 37.5%) and sub-Saharan Africa (59.8 million or 20.5%) accounted for more than half of all children and adolescents with disabilities (Fig 3). High-income North America (5.6 million or 1.9%) and Western Europe (6.2 million or 2.1%) accounted for the lowest population of children and adolescents with disabilities.

Globally, mild intellectual disability (IQ scores of 50–69) was the most prevalent disability, and mild vision loss was the least prevalent disability among the 4 types of disability (Fig 3). Within regions, mild hearing loss was the most common disability in all regions except Central and Eastern Europe and Central Asia and Southeast and East Asia and Oceania. Mild vision loss was the least prevalent disability in all regions.

Severe epilepsy and severe intellectual disability were the 2 most common disabilities with the highest YLD globally and in all regions. The burden of epilepsy was more concentrated in Mexico, Colombia, and Venezuela in Latin America and was more concentrated in Gabon, the Republic of the Congo, and Angola in sub-Saharan Africa (Fig 4). Intellectual disability had the highest prevalence in India (South Asia), Afghanistan, and Yemen (Middle East). Hearing loss was most prevalent in Madagascar (sub-Saharan Africa) and Myanmar (Southeast Asia), whereas vision loss was more widespread and had the highest prevalence in South Sudan, the Central African Republic (sub-Saharan Africa), and Papua New Guinea (Oceania).

The top 10 countries accounted for 52.8% of all children and adolescents with epilepsy, 68.0% of children and adolescents with intellectual disability, 62.0% of children and adolescents with hearing loss, and 59.4% of children and adolescents with vision loss (Supplemental Fig 6). The top 10 countries accounted for 62.3% of all children and adolescents with these disabilities. These countries also accounted for at least 53.5% of the YLD associated with these conditions. India and China had the highest population of children and adolescents with any disability, with their associated YLD. The United States was the only high-income country among the top 10 countries for any disability. However, in terms of the highest prevalence and YLD rates per population, countries with the highest prevalence were Gabon for epilepsy, India for intellectual disability, Madagascar for hearing loss, and Israel for vision loss. The underlying causes or risk factors and their ICD-9 and ICD-10 codes that formed the basis of the reported estimates for all disabilities in the GBD 2017, as well as their contributions to the aggregate estimate for each disability, are summarized in Supplemental Fig 7.

DISCUSSION

Our primary aim was to update the global estimate of children and adolescents with disabilities previously attributed to the GBD 2004 and still widely reported in the literature.[2–9] Although, in our study,

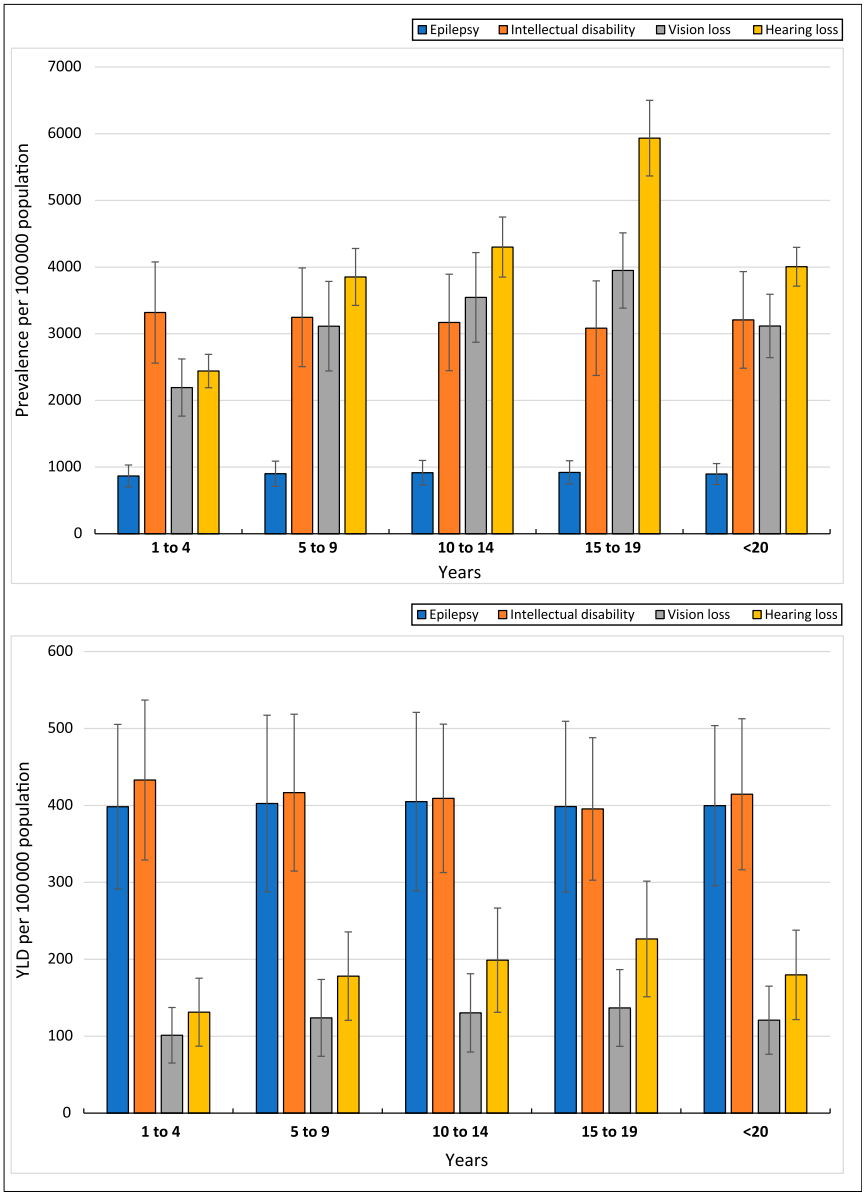

FIGURE 1
Global age-specific prevalence of and YLD for childhood epilepsy, intellectual disability, hearing loss and vision loss in 2017.

we did not capture the full spectrum of all possible childhood disabilities, our analysis reveals that the number of children and adolescents with disabilities is at least 291 million globally and that the prevalence increases with age. Among children and adolescents <15 years, the estimate of children and adolescents with these 4 disabilities is more than twice the 2004 estimate of 93 million. The substantially higher estimate can be attributed to several factors besides the modest impact of the ~6.6% and 4.1% rise in the global population of children and adolescents <15 and <20 years, respectively, between 2004 and 2017.[25] Firstly, the number and variety of data sources used in generating estimates have increased substantially since 2004. Secondly, the modeling techniques have improved significantly on the basis of expert contributions from an increasing number of institutional and individual collaborators from 146 countries.[26] Thirdly, consistent with the classification recommended by the ICF, the GBD 2017 estimates include disabilities of varying degrees of severity from slight or mild to profound for each disability. Lastly, there is now an internationally agreed on framework for evaluating estimates of health from statistical modeling, which has been strictly followed by the GBD since 2015.[24]

The GBD modeling efforts are meant to bridge a critical gap in the epidemiology of developmental disorders resulting from several conceptual and operational challenges in measuring disabilities in children and adolescents.[27,28] As with most health conditions, the dearth of population-based data for specific disabilities, especially in LMIC, has compelled a growing reliance on the statistical estimation of health outcomes as an interim step to guide health policy and intervention. The implicit philosophy underpinning these efforts is that the absence of conventional epidemiological data is not evidence of the absence of a health condition. Thus, GBD is an essential, independent, and up-to-date source of alternative data for policy-makers and decision-makers in global health, especially for countries with poor or no data.[2,3]

However, it is helpful to evaluate the plausibility of the GBD estimates in the absence of comparable global estimates from other reputable sources. The global estimate of 0.9% (95% UI: 0.8%–1.1%) for epilepsy among all children and adolescents appears plausible on the basis of evidence in the literature, suggesting a global prevalence of between 0.5% and 1%.[29,30] In addition, the estimate of 1.0% (95% UI: 0.8%–1.3%) for sub-Saharan Africa is consistent with the 0.9% reported in the most comprehensive systematic review on epilepsy to date from this region.[31] The GBD estimate for intellectual disability of 3.2% (95% UI:

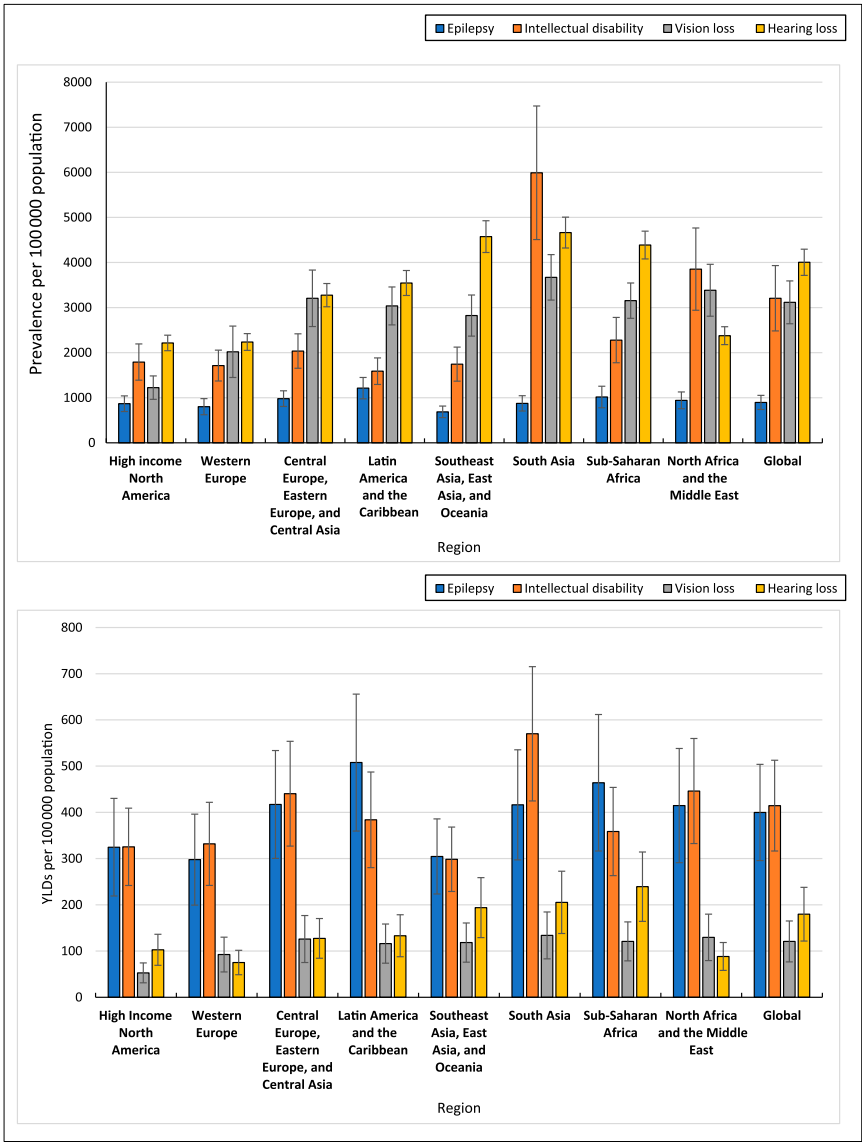

FIGURE 2

Regional prevalence of and YLD for childhood epilepsy, intellectual disability, hearing loss and vision loss in 2017.

2.5%–3.9%) was higher than the estimate of 1.8% reported in 1 meta-analysis of population-based studies, possibly because of the inclusion of children and adolescents with comorbid autism spectrum disorder and cerebral palsy secondary to neonatal encephalopathy in the GBD.[32,33] South Asia substantially contributed to the reported global estimates for intellectual disability, and the age-specific GBD estimates for this region are supported by a recent robust population-based study from India in which a prevalence of 5.2% was reported.[34] Sensory disabilities are perhaps the most researched childhood disabilities worldwide. Several studies in school-aged children support the reported estimates for vision loss and hearing loss, with most suggesting that the GBD estimates were conservative.[35–38] For example, in 1 systematic review of childhood hearing loss, a prevalence of between 0.8% and 46.7% was reported across 26 well-conducted studies from different regions,[36] whereas 2 population-based studies from Canada and the United Sates revealed estimates of between 4.5% and 7.9%, compared with a GBD estimate of 2.2% for North America. More crucially, these findings underscore the need to develop local capacity toward early identification and timely on-going support for children and adolescents with any disability and their families, especially in high-burden LMIC. The unique challenges faced by children with disabilities as they transition into adolescence also need to be recognized and addressed.[39]

This study has several limitations worth emphasizing. Most importantly, our main finding must be regarded as a conservative estimate of children with disabilities in general because this study was restricted to 4 conditions. The inclusion of conditions such as cerebral palsy without comorbid intellectual disability would have increased the reported estimates in our article. Additionally, the GBD 2017 has methodologic limitations that have been extensively described in previous publications in accordance with the Guidelines for Accurate and Transparent Health Estimates Reporting.[16–18] For example, the 95% UIs around estimates for regions with sparse data are still wide. Most of the uncertainty in the YLD estimates results from the current limitations in the determination of disability weights that may be minimized in the future by removing some of the ambiguities in lay descriptions and increasing the volume of survey data. In addition, despite the continuous efforts toward improving the GBD methodology, concerns remain on estimating the prevalence of disabilities solely as sequelae of health conditions.[2,3,40] Furthermore, the estimates do not fully reflect the complex and dynamic relationship between health conditions and contextual personal or environmental

	Global	North America	Western Europe	Central, Eastern Europe, and Central Asia	Latin America and the Caribbean	Southeast Asia, East Asia, and Oceania	South Asia	Sub-Saharan Africa	North Africa and the Middle East
Prevalence									
Treated epilepsy	12	5	5	9	9	12	14	17	10
Moderate epilepsy	8	7	10	8	5	9	9	8	5
Severe epilepsy	6	8	8	7	4	8	7	7	4
Borderline intellectual disability	10	11	12	11	10	4	5	3	9
Mild intellectual disability	1	3	3	3	3	2	3	4	3
Moderate intellectual disability	5	10	7	6	6	5	6	11	7
Severe intellectual disability	9	9	6	4	7	6	8	6	8
Profound intellectual disability	17	17	17	17	14	13	16	12	14
Mild hearing loss	2	1	1	2	1	3	1	1	1
Moderate hearing loss	4	4	4	5	8	7	4	5	6
Moderately severe hearing loss	7	6	9	10	11	11	10	9	11
Severe hearing loss	11	13	16	14	17	17	11	10	15
Profound hearing loss	13	12	13	13	15	14	12	13	12
Complete hearing loss	16	16	15	16	16	16	17	16	16
Mild vision loss	18	18	18	18	18	18	18	18	18
Moderate vision loss	3	2	2	1	2	1	2	2	2
Severe vision loss	15	15	11	12	12	10	13	14	13
Blindness	14	14	14	15	13	15	15	15	17
YLD									
Treated epilepsy	17	6	7	8	10	16	17	17	14
Moderate epilepsy	3	4	4	3	3	3	5	3	3
Severe epilepsy	1	1	1	1	1	1	1	1	1
Borderline intellectual disability	16	10	10	15	16	15	14	16	11
Mild intellectual disability	5	5	6	6	7	7	4	6	5
Moderate intellectual disability	4	3	3	4	4	4	3	4	4
Severe intellectual disability	2	2	2	2	2	2	2	2	2
Profound intellectual disability	13	13	13	17	17	17	8	15	9
Mild hearing loss	7	8	8	7	6	6	7	10	8
Moderate hearing loss	12	14	12	13	12	12	10	12	15
Moderately severe hearing loss	11	12	16	11	13	10	9	11	13
Severe hearing loss	10	16	17	14	15	11	12	5	16
Profound hearing loss	9	9	15	10	11	9	11	9	12
Complete hearing loss	15	11	14	16	14	13	16	13	17
Mild vision loss	18	18	18	18	18	18	18	18	18
Moderate vision loss	6	7	5	5	5	5	6	8	6
Severe vision loss	14	15	11	12	9	14	15	14	7
Blindness	8	17	9	9	8	8	13	7	10

FIGURE 3

Regional ranking of childhood epilepsy, intellectual disability, hearing loss, and vision loss by severity among children and adolescents based on estimates of prevalence and YLD in 2017. Colors correspond to the ranking of disability by severity, with dark red indicating the most common disability and dark green indicating the least common disability for the location indicated. The numbers inside each box indicate the ranking.

factors, as envisaged under the ICF, and so provide a limited picture of disability.[15] Finally, it was difficult to completely and precisely account for children with multiple disabilities and across multiple developmental domains. These considerations reveal the need for complementary nationally representative disability data, such as those published periodically by the United Nations Children's Fund and the WHO, that can be used as additional data inputs for the GBD. Although estimates of disabilities from both statistical modeling and household surveys are not definitive, they reflect current knowledge and the best available evidence to inform policies and interventions.

CONCLUSIONS

In the most recent GBD, it is shown that the number of children and adolescents with disabilities globally far exceeds the estimate in 2004. The burden of disability is substantial from early childhood and corroborates our earlier report on the need to address the quality of life of many beneficiaries of the child survival programs during the era of the Millennium Development Goals (2000–2015).[18] The risk likely to be faced by the affected children and adolescents of not realizing their full potential, especially in LMIC, as envisaged under the SDGs era, is real and disturbing. Regardless of the inherent limitations of modeled estimates, the findings from our analysis are plausible and insightful. These findings shed light on the high and growing health needs among child survivors that warrant significant investments and should be a wake-up call to public health leaders and advocates globally. A committed global leadership will ensure that these and other vulnerable children and adolescents are truly not left behind in accordance with the obligations under the Convention on the Rights of the Child and the Convention on the Rights of Persons with Disabilities.

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ABBREVIATIONS

GBD: Global Burden of Disease Study
ICD-9: *International Classification of Disease, Ninth Revision*
ICD-10: *International Classification of Disease, 10th Revision*
ICF: International Classification of Functioning, Disability, and Health
LMIC: low- and middle-income countries
SDG: sustainable development goal
UI: uncertainty interval
WHO: World Health Organization
YLD: years lived with disability

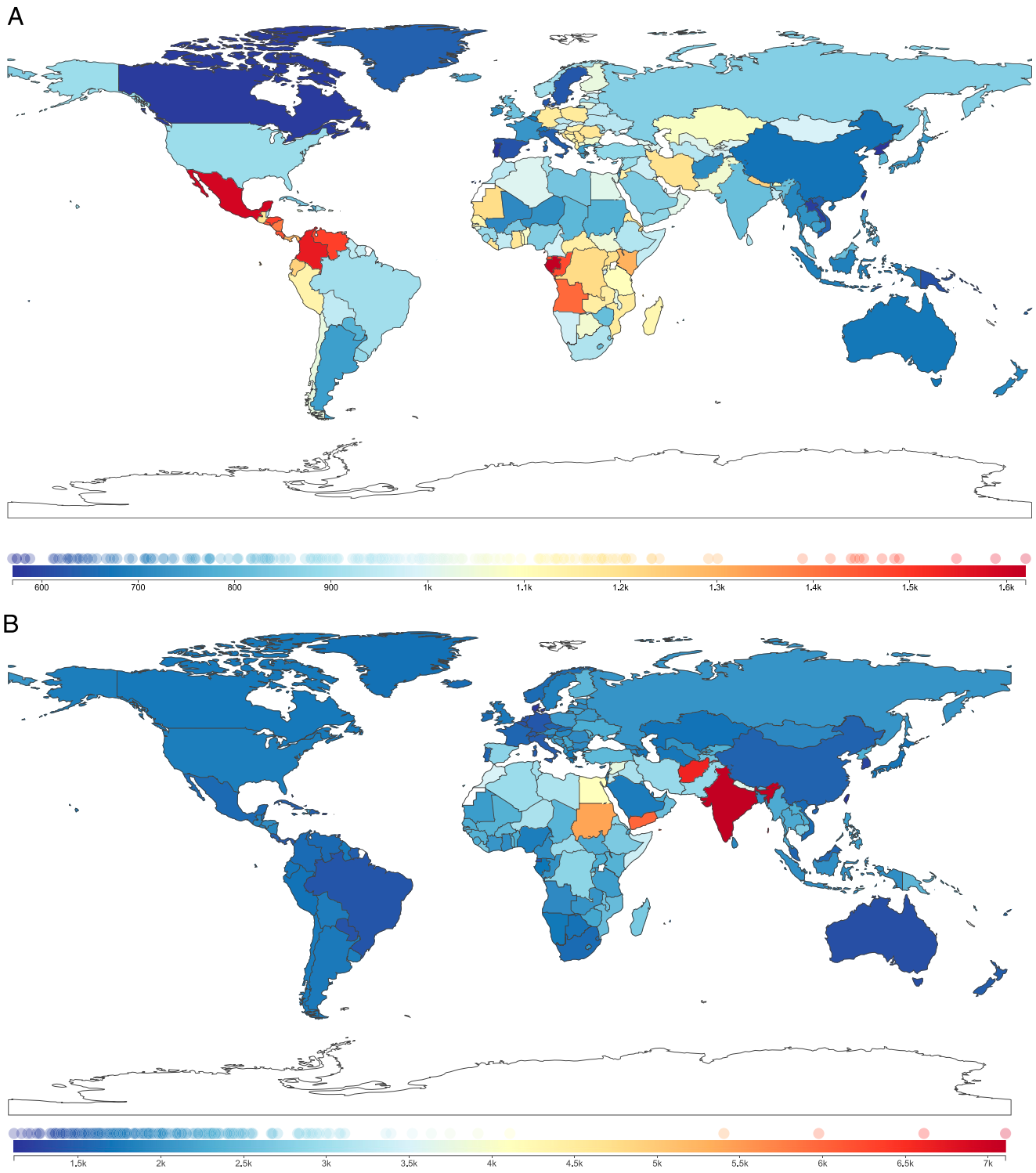

FIGURE 4

Global distribution of childhood epilepsy, intellectual disability, hearing loss and vision loss in 2017. A, Epilepsy, both sexes, <20 years, 2017, prevalent cases per 100 000. B, Developmental intellectual disability, both sexes, <20 years, 2017, prevalent cases per 100 000. C, Hearing loss, both sexes, <20 years, 2017, prevalent cases per 100 000. D, Blindness and vision impairment, both sexes, <20 years, 2017, prevalent cases per 100 000.

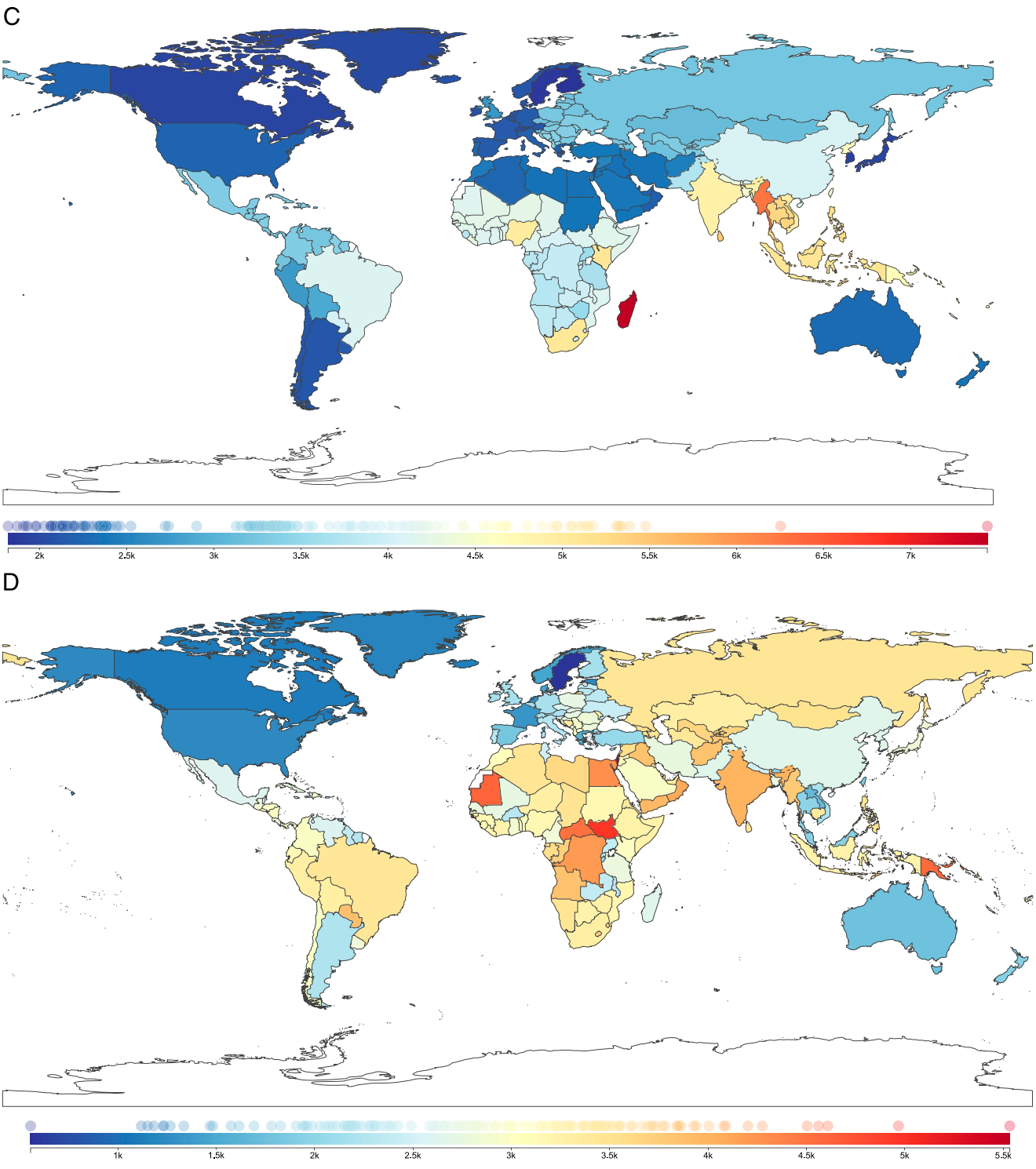

FIGURE 4
Continued.

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